

the top of the mouth of the drive, there was then confined air (not compressed), as follows:—In the drive, 1,400 cubic feet; in cross-cut, 2,520 cubic feet; total, 3,920 cubic feet. When the water rose to its highest level (52 feet, equal to about one-and-a-half atmospheres) in the shaft; the confined air was then compressed, according to Boyle and Mariottes' law, to two-fifths or a little less than one-half of its original volume. The space thus occupied by the compressed air, under a pressure of a column of water equal to $1\frac{1}{2}$ atmospheres, would be 1,568 cubic feet. The measurements of drive, cross-cut, and height of water in the shaft are only approximate, having been given by the mining manager, Mr. Jackson, roughly; but they are sufficiently near for all practical purposes, and fully establish the fact that there was a large quantity of compressed air surrounding McCaviston at the end of the drive.

ART. IV.—*Observations on Sand-dunes of the Coast of Victoria.* By R. ETHERIDGE, ESQ., Jun.

(OF THE GEOLOGICAL SURVEY OF SCOTLAND.)

[Read 8th June, 1874.]

The general characters and nature of the sand-dunes of the coast of Victoria are too well known to the members of the Royal Society to need any lengthened description from me. I shall, therefore, confine myself to a few general observations connected with the subject.

The usual aspect of that portion of the coast occupied by dunes is low and sandy, rising here and there into hills a few hundred feet high, and composed almost wholly of blown sand. Portions of the coast at which these phenomena may advantageously be studied are, amongst others, Anderson's Inlet, Point Nepean, and the coast line at intervals from Cape Otway far into the colony of South Australia. From accounts given by various writers, we may consider the sand of the coast as forming three kinds of hillocks, viz., high well-grassed lengthened ridges; similar detached more or less conical hills; and lastly, shifting dunes, devoid of vegetation, and changing their form and position with every breath of wind. One of the more remarkable instances of the long ridge-like dune is that described by Mr. C. S. Wilkinson, on the west side of the Aire River, near Cape

Otway,* where a bank of sand runs for about a quarter of a mile east and west, at a nearly uniform height of 50 feet, much resembling a railway embankment.

The height of the coast dunes varies somewhat. Around Anderson's Inlet I saw them from 200 to 250 feet high; at Cape Otway the extreme height appears to be about 200 feet; whilst the Rev. J. E. T. Woods has recorded certain dunes on the coast of South Australia, between the mouth of the River Glenelg and Cape Bridgewater, as high as 300 feet, extending three or four miles inland, and fast encroaching on habitable ground.† At Cape Otway the dunes extend some two or three miles inland, frequently in the form of small sandy hummocks surrounding a basin-shaped depression without outlet, resembling the "cups" of the Cape Schanck district.‡

The sand varies in colour from white to yellow, in places very siliceous, whilst at others silex is in the smallest proportion, the general mass then consisting of fine fragments of Echini spires, Polyzoa, pieces of shells, Foraminifera, and sponge spiculæ, with little or no stratification.§

In describing the high sand hills on the eastern side of the Aire River, Mr. Wilkinson says that the sand washed up on the shore is swept away by the strong south-westerly gales, and carried to the north-east, up a gradual but irregular incline, for about three-quarters of a mile, when it falls over a steep bank some 50 feet high, burying trees and shrubs in its progress,|| and thus covering up the face of the country.

Mr. Wilkinson kindly communicated to me some observations taken by Mr. H. Ford, of Cape Otway, relative to the angle of the steepest slope of the sand hills. The result of eleven observations is as follows—30°, 31°, 32°, 30°, 33°, 30°, 32°, 35°, 36°, 32°, 35°. It will be observed that the average angle of inclination is 32°, the greatest 36°, the least 30°. The greatest angles were just at the top of inclined surfaces, where the least thing would set sand in motion.

The sand dunes seldom contain whole or perfect shells, or large organisms of any kind, although Mr. Ford found in the dunes two miles to the east of Cape Otway lighthouse, bones of animals, flint chips, a sharpened stone tomahawk, and

* Report on Geology of Cape Otway District, 1865, p. 26.

† Geological Observations in South Australia, 1862, p. 219.

‡ Wilkinson, *op. cit.*, p. 28.

§ Geological Observations in South Australia, 1862, p. 189.

|| Wilkinson, *op. cit.*, p. 28.

several bone spikes or needles, relics of the past tribes of the Cape. At about the same distance from the lighthouse, in a mixture of beach material, pebbles, humus, and broken shells, resting on the Carbonaceous sandstone forming the high cliffs of the cape, and apparently intermediate between it and the overlying dunes, I, in company with Mr. H. Ford, obtained a similar bone spike, with numerous seal bones, a ramus of the lower jaw, pieces of vertebræ, bones of the limbs, and a few pieces of ribs, whilst the shells appeared to be those existing on the coast at the present day.

Both at the Cape and along the South Australian coast peculiar concretions are to be met with in the dunes, often assuming fantastic shapes and forms, generally resembling trees with their branches. Indeed, for such they have frequently been taken; for, amongst others, Mr. T. Burr describes calcified stems of trees standing in the position of their growth in the sand-dunes of St. Vincent's Gulf, near Adelaide.* The same phenomena were likewise noticed by the late Professor Jukes at the entrance of the Swan River, Western Australia.† Along that coast, hills 200 to 300 feet high, forming districts stretching as much as ten miles inland, are formed of once drifted sand, now consolidated, and supporting a good forest vegetation. This deposit consists chiefly of fragmentary shells solidified into a compact stone, sufficiently hard for building purposes. Scattered plentifully through such material, Professor Jukes saw similar pipe and tree-like concretions, often ending downwards in tapering forms like stalagmites. According to the Rev. J. E. T. Woods. these "pseudo trees" are composed of a magnesian limestone.‡

On comparing the sand-dunes of the British coasts we find nothing to equal those of the coasts of Australia, although Sir C. Lyell has placed on record a rather interesting case of the shifting nature of sand, which may be of interest. All that now remains of the ancient village of Eccles, on the coast of Norfolk, is the ruined tower of the once considerable chapel, which, extant in 1605 A.D., was in 1839 almost completely buried in large dunes, locally called "Marrams." The action of the wind between this and 1862, a space of 23 years, was such that at that date the foundations of the edifice were exposed, and the surrounding dunes almost

* Inst. Jour. Geol. Soc., xvi.

† Manual of Geology, 1862, p. 155.

‡ Geol. Observations, 1862, p. 168.

swept away.* M. Elie de Beaumont advanced the theory that sand-dunes might serve as natural chronometers, by which the date of the existing continents may be ascertained; that by observing the rate at which the particles of sand travel, we may calculate the period when the movement commenced.† Sir C. Lyell, however, doubts the correctness of this theory, observing that “this test must be applied with great caution, so variable is the rate at which sand may advance into the interior.‡

ART. V.—*On Abyssinian Tube Wells.*

By FRANCIS CORBETT, ESQ.

[Read 13th July, 1874.]

These pumps were constructed of six lengths of ordinary iron piping for gas pipes, each of six feet long. Into one of these lengths was screwed a piece of solid iron, pointed, about eight inches long, and the shoulder next the pipe was made of a greater diameter than the pipe. This is for driving into the ground, and the diameter being greater than the pipe, it clears the way, especially where the holes are made in the pipe. Just above where this solid point is screwed, holes are drilled in the pipe for the water to enter, just as in any ordinary tubing for a well, for sixteen or eighteen inches in length. The number of these holes must of course be in proportion to the size of the pump, so as to admit as much water as the pump is capable of throwing. Less holes would be required in a small pump, suitable either for domestic purposes, or for a small paddock. The pumps I got Mr. Danks to adapt the pipes for were No. 6 Douglas, the largest size made by that manufacturer. They are as large as can be reasonably worked by manual labour, and the larger the pump the better, as it takes the man less time to fill the troughs. Mr. Danks' arrangement for attaching the different lengths of the piping to one another is very good, as the pipes preserve their full strength. He has a ring or hoop about three inches broad, tapped from both ends, with right and left handed internal screws. The ends of the pipes have screw threads worked on the outside of them,

* Principles of Geology, 1867, i., p. 513.

† Géologie Pratique, p. 218.

‡ Principles of Geology, 1867, i., p. 516.